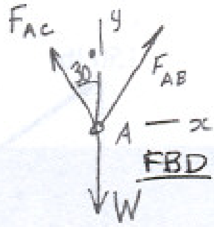
Curtis Kelly

Given:

1. Determine the maximum weight W that can be supported in the position shown if each cable AC and AB can support a maximum tension of 600 lb before it fails.

Find: W_{max}.



Sol'n $\Sigma F_A = 0$ for equilibrium

$\Sigma F_x = 0;\ \frac{5}{13} F_{AB} - \sin 30^\circ F_{AC} = 0$

$F_{AC} = \frac{5 F_{AB}}{13\ (0.5)}$

$F_{AC} = 0.7692 F_{AB}$

So $F_{AB} > F_{AC}$, let $F_{AB} = 600$ lb

$\Sigma F_y = 0;\ F_{AC} \cos 30^\circ + F_{AB} \frac{12}{13} - W = 0$

Substituting $0.7692 (600 lb) \cos 30^\circ + 600 (\frac{12}{13}) = W$

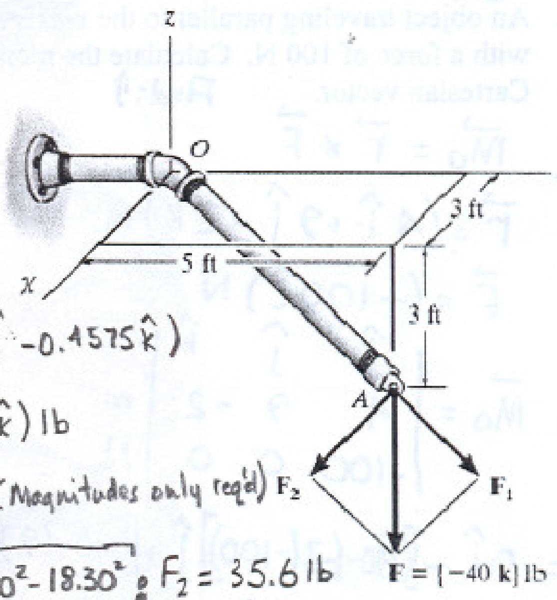
$\therefore W = 953.55$ lb.

$W_{MAX} = 954$ lb

Given:

2. A force of $\mathbf{F} = \{-40\ \mathbf{k}\}$ lb acts at the end of the pipe. Determine the magnitudes of the components $\mathbf{F}_1$ and $\mathbf{F}_2$, which are directed along the pipe's axis and perpendicular to it, as shown.

Find:



Sol'n.

$F_1 = \hat{u}_{OA} \cdot \vec{F} = F_{//OA}\ ;\ \sqrt{F_{//OA}^2 + F_{\perp OA}^2} = F$

$\hat{u}_{OA} = \frac{\vec{r}_{OA}}{|r_{OA}|}$ $\quad \vec{r}_{OA} = (3\hat{i} + 5\hat{j} - 3\hat{k})$ ft

$\hat{u}_{OA} =$ $\quad |r_{OA}| = \sqrt{3^2 + 5^2 + 3^2}$

$|r_{OA}| = 6.557$ ft

$\hat{u}_{OA} = \frac{3\hat{i} + 5\hat{j} - 3\hat{k}}{6.557} = (0.4575\hat{i} + 0.7625\hat{j} - 0.4575\hat{k})$

$F_{//OA} = (0.4575\hat{i} + 0.7625\hat{j} - 0.4575\hat{k}) \cdot (-40\hat{k})$ lb

$F_1 = F_{//OA} = +18.30$ lb directed // to OA (Magnitudes only req'd)

$F_2 = F_{\perp OA};\ F_2 = \sqrt{F^2 - F_1^2}\ ;\ F_2 = \sqrt{40^2 - 18.30^2}\ ;\ F_2 = 35.6$ lb

Find:

3. Determine the magnitudes of $\mathbf{F}_1$, $\mathbf{F}_2$ and $\mathbf{F}_3$ for equilibrium of the particle.

Sol'n $\Sigma F_x = 0$; $\Sigma F_y = 0$; $\Sigma F_z = 0$ for equilibrium

Given Figure below:

F_2 along z axis is $F_2 \hat{k}$

F_3 along $-y$ axis is $-F_3 \hat{j}$

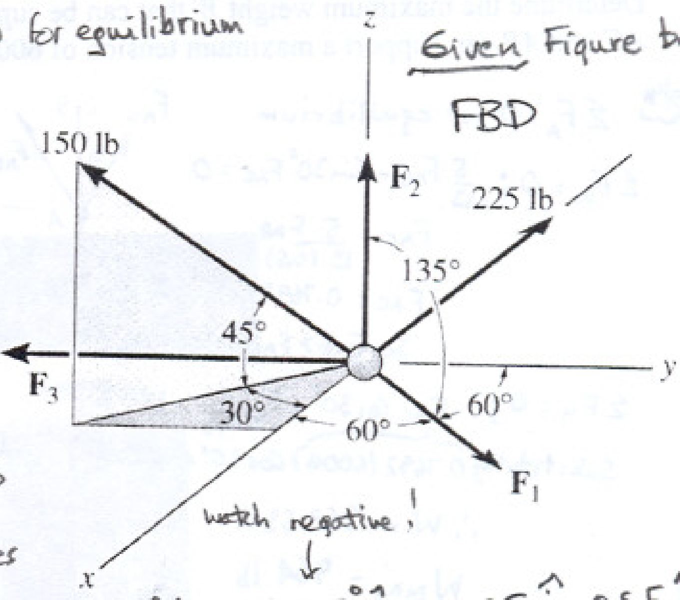
For 150 lb $F_x = 150 \cos 45° \cos 30°$

$F_x = (91.85 \hat{i})$ lb

$F_y = -150 \cos 45° \sin 30° =$

$F_y = (-53.03 \hat{j})$ lb

$F_z = 150 \sin 45° = (106.07 \hat{k})$ lb



For 225 lb force $(-225 \hat{i})$ lb applies

Components of F_1 are $F_1 \cos 60° \hat{i} + F_1 \cos 60° \hat{j} + F_1 \cos 135° \hat{k} = 0.5 F_1 \hat{i} + 0.5 F_1 \hat{j} - 0.7071$

Write $\Sigma F_x = 0$; $-225\hat{i} + 91.85\hat{i} + 0.5 F_1 \hat{i} = 0$, So $F_1 = 266.3$ lb.

Write $\Sigma F_y = 0$; $-F_3 \hat{j} + 266.3(0.5)\hat{j} - 53.03\hat{j} = 0$; So $F_3 = 266.3(0.5) - 53.03 = 80.$

Write $\Sigma F_z = 0$; $F_2 \hat{k} - 266.3(0.7071)\hat{k} + 106.07\hat{k} = 0$; $F_2 = 82.23$ lb.

Rounding Values $F_1 = 266$ lb, $F_2 = 82.2$ lb, $F_3 = 80.1$ lb as shown on

Given:

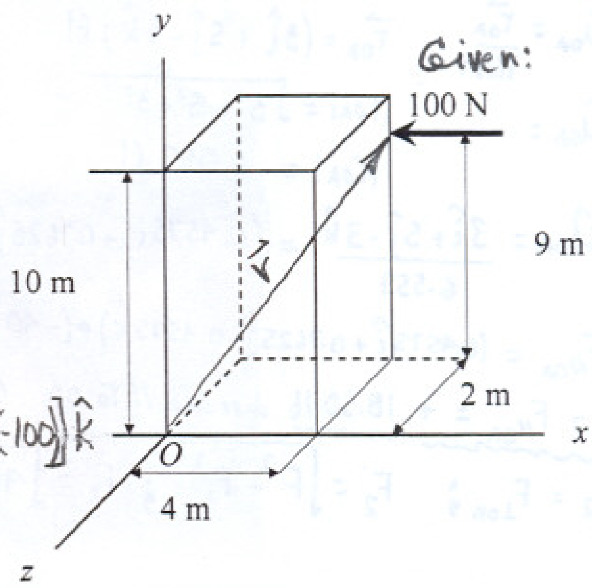
4. An object traveling parallel to the x-axis strikes the block, as shown, 9 m above ground level, with a force of 100 N. Calculate the moment developed about the origin, expressing it as a Cartesian vector. Find: $\vec{M}$

Sol'n $\vec{M}_O = \vec{r} \times \vec{F}$

$\vec{r} = (4\hat{i} + 9\hat{j} - 2\hat{k})$ m

$\vec{F} = (-100\hat{i})$ N

$$\vec{M}_O = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 4 & 9 & -2 \\ -100 & 0 & 0 \end{vmatrix} \begin{matrix} \\ m \\ N \end{matrix}$$



$\vec{M}_O = 0\hat{i} - [(4)0 - (-2)(-100)]\hat{j} + [(4)0 - (9)(-100)]\hat{k}$

$\vec{M}_O = \{+200\hat{j} + 900\hat{k}\}$ Nm